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Advanced Simulation and Computing

FY11–12 IMPLEMENTATION PLAN

Volume 2, Rev. 0

May 5, 2010

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I. Executive Summary

The Stockpile Stewardship Program (SSP) is a single, highly integrated technical program for maintaining the surety and reliability of the U.S. nuclear stockpile. The SSP uses past nuclear test data along with current and future non-nuclear test data, computational modeling and simulation, and experimental facilities to advance understanding of nuclear weapons. It includes stockpile surveillance, experimental research, development and engineering (D&E) programs, and an appropriately scaled production capability to support stockpile requirements. This integrated national program requires the continued use of current facilities and programs along with new experimental facilities and computational enhancements to support these programs.

The Advanced Simulation and Computing Program (ASC)¹ is a cornerstone of the SSP, providing simulation capabilities and computational resources to support the annual stockpile assessment and certification, to study advanced nuclear weapons design and manufacturing processes, to analyze accident scenarios and weapons aging, and to provide the tools to enable stockpile Life Extension Programs (LEPs) and the resolution of Significant Finding Investigations (SFIs). This requires a balanced resource, including technical staff, hardware, simulation software, and computer science solutions.

In its first decade, the ASC strategy focused on demonstrating simulation capabilities of unprecedented scale in three spatial dimensions. In its second decade, ASC is focused on increasing its predictive capabilities in a three-dimensional (3D) simulation environment while maintaining support to the SSP. The program continues to improve its unique tools for solving progressively more difficult stockpile problems (focused on sufficient resolution, dimensionality and scientific details); to quantify critical margins and uncertainties (QMU); and to resolve increasingly difficult analyses needed for the SSP. Moreover, ASC has restructured its business model from one that was very successful in delivering an initial capability to one that is integrated and focused on requirements-driven products that address long-standing technical questions related to enhanced predictive capability in the simulation tools.

ASC must continue to meet three objectives:

- **Objective 1. Robust Tools.** Develop robust models, codes, and computational techniques to support stockpile needs such as refurbishments, SFIs, LEPs, annual assessments, and evolving future requirements.
- **Objective 2. Prediction through Simulation.** Deliver validated physics and engineering tools to enable simulations of nuclear weapons performance in a variety of operational environments and physical regimes and to enable risk-informed decisions about the performance, safety, and reliability of the stockpile.
- **Objective 3. Balanced Operational Infrastructure.** Implement a balanced computing platform acquisition strategy and operational infrastructure to meet Directed Stockpile Work (DSW) and SSP needs for capacity and high-end simulation capabilities.

¹ In FY02 the Advanced Simulation and Computing (ASC) Program evolved from the Accelerated Strategic Computing Initiative (ASCI).

II. Introduction

The ASC Program supports the National Nuclear Security Administration's (NNSA's) overarching goal of Nuclear Weapons Stewardship: *"We continue to advance the Stockpile Stewardship Program to push the scientific and engineering boundaries needed to maintain our nuclear arsenal. It also means maintaining the basic science and engineering that is the foundation of the weapons program."*²

In 1996, ASCI—the Accelerated Strategic Computing Initiative—was established as an essential element of the SSP to provide nuclear weapons simulation and modeling capabilities.

In 2000, the NNSA was established to carry out the national security responsibilities of the Department of Energy (DOE), including maintenance of a safe, secure, and reliable stockpile of nuclear weapons and associated materials capabilities and technologies.

Shortly thereafter, in 2002, ASCI matured from an initiative to a recognized program and was renamed the Advanced Simulation and Computing (ASC) Program.

Prior to the start of the nuclear testing moratorium in October 1992, the nuclear weapons stockpile was maintained through (1) underground nuclear testing and surveillance activities and (2) "modernization" (i.e., development of new weapons systems). A consequence of the nuclear test ban is that the safety, performance, and reliability of U.S. nuclear weapons must be ensured by other means for systems far beyond the lifetimes originally envisioned when the weapons were designed.

NNSA will carry out its responsibilities through the twenty-first century in accordance with the current Administration's vision and the Nuclear Posture Review (NPR) guidance. NNSA Administrator Thomas P. D'Agostino summarized³ the NNSA objectives for SSP as follows:

"Our fundamental national security responsibilities for the United States include:

- Assuring the safety, security and reliability of the U.S. nuclear weapons stockpile while at the same time transforming the stockpile and the infrastructure that supports it;*
- Reducing the threat posed by nuclear proliferation; and,*
- Providing reliable and safe nuclear reactor propulsion systems for the U.S. Navy."*

"Throughout the past decade, the Stockpile Stewardship Program (SSP) has proven its ability to successfully sustain the safety, security and reliability of the nuclear arsenal without resorting to underground nuclear testing. The SSP also enables the U.S. to provide a credible strategic deterrent capability with a stockpile that is significantly smaller. To assure our ability to maintain essential military capabilities over the long-term, however, and to enable significant reductions in reserve warheads, we must make progress towards a truly responsive nuclear weapons infrastructure as called for in the Nuclear Posture Review (NPR). The NPR called for a transition from a threat-based nuclear deterrent, with large numbers of deployed and reserve weapons, to a deterrent that is based on capabilities, with a smaller nuclear weapons stockpile and

² NNSA Strategic Planning Guidance for FY2010–2014, April 2008, page 17.

³ Testimony on the FY 2008 National Defense Authorization Budget Request for the Department of Energy's NNSA before the House Armed Services Subcommittee, March 20, 2007.

greater reliance on the capability and responsiveness of the Department of Defense (DoD) and NNSA infrastructure to adapt to emerging threats.”

A truly responsive infrastructure will allow us to address and resolve any stockpile problems uncovered in our surveillance program; to adapt weapons (achieve a capability to modify or repackage existing warheads within 18 months of a decision to enter engineering development); to be able to design, develop, and initially produce a new warhead within three to four years of a decision to do so;⁴ to restore production capacity to produce new warheads in sufficient quantities to meet any defense needs that arise without disrupting ongoing refurbishments; to ensure that services such as warhead transportation, tritium support, and other ongoing support efforts are capable of being carried out on a time scale consistent with the DoD’s ability to deploy weapons; and to improve test readiness (an 18-month test readiness posture) in order to be able to diagnose a problem and design a test that could confirm the problem or certify the solution (without assuming any resumption of nuclear testing).

Additionally, the NPR guidance has directed that NNSA maintain a research and development (R&D) and manufacturing base that ensures the long-term effectiveness of the nation’s stockpile and begin a modest effort to examine concepts (for example, Advanced Concepts Initiatives) that could be deployed to further enhance the deterrent capabilities of the stockpile in response to the national security challenges of the twenty-first century.

The ASC Program plays a vital role in the NNSA infrastructure and its ability to respond to the NPR guidance. The program focuses on development of modern simulation tools that can provide insights into stockpile problems, provide tools with which designers and analysts can certify nuclear weapons, and guide any necessary modifications in nuclear warheads and the underpinning manufacturing processes. Additionally, ASC is enhancing the predictive capability necessary to evaluate weapons effects, design experiments, and ensure test readiness.

ASC continues to improve its unique tools to solve progressively more difficult stockpile problems, with a focus on sufficient resolution, dimensionality, and scientific details, to enable QMU and to resolve the increasingly difficult analyses needed for stockpile stewardship. The DSW provides requirements for simulation, including planned LEPs, stockpile support activities that may be ongoing or require short-term urgent response, and requirements for future capabilities to meet longer-term stockpile needs. Thus, ASC’s advancing, leading-edge technology in high-performance computing (HPC) and predictive simulation meets these short- and long-term needs, including the annual assessments and certifications and SFIs. The following section lists past, present, and planned ASC contributions to meet these needs.

ASC Contributions to the Stockpile Stewardship Program

In FY96, ASCI Red was delivered. Red, the world’s first teraFLOPS supercomputer, was upgraded to more than 3 teraFLOPS in FY99 and was retired from service in September 2005.

In FY98, ASCI Blue Pacific and ASCI Blue Mountain were delivered. These platforms were the first 3-teraFLOPS systems in the world and have both since been decommissioned.

⁴ While there are no plans to develop new weapons, acquiring such capability is an important prerequisite to deep reductions in the nuclear stockpile.

In FY00, ASCI successfully demonstrated the first-ever 3D simulation of a nuclear weapon primary explosion and the visualization capability to analyze the results; ASCI successfully demonstrated the first-ever 3D hostile-environment simulation; and ASCI accepted delivery of ASCI White, a 12.3-teraFLOPS supercomputer, which has since been retired from service.

In FY01, ASCI successfully demonstrated simulation of a 3D nuclear weapon secondary explosion; ASCI delivered a fully functional Problem Solving Environment for ASCI White; ASCI demonstrated high-bandwidth distance computing between the three national laboratories; and ASCI demonstrated the initial validation methodology for early primary behavior. Lastly, ASCI completed the 3D analysis for a stockpile-to-target sequence for normal environments.

In FY02, ASCI demonstrated 3D system simulation of a full-system (primary and secondary) thermonuclear weapon explosion, and ASCI completed the 3D analysis for an STS abnormal-environment crash-and-burn accident involving a nuclear weapon.

In FY03, ASCI delivered a nuclear safety simulation of a complex, abnormal, explosive initiation scenario; ASCI demonstrated the capability of computing electrical responses of a weapons system in a hostile (nuclear) environment; and ASCI delivered an operational 20-teraFLOPS platform on the ASCI Q machine, which has been retired from service.

In FY04, ASC provided simulation codes with focused model validation to support the annual certification of the stockpile and to assess manufacturing options. ASC supported the life-extension refurbishments of the W76 and W80, in addition to the W88 pit certification. In addition, ASC provided the simulation capabilities to design various non-nuclear experiments and diagnostics.

In FY05, ASC identified and documented SSP requirements to move beyond a 100-teraFLOPS computing platform to a petaFLOPS-class system; ASC delivered a metallurgical structural model for aging to support pit-lifetime estimations, including spiked-plutonium alloy. In addition, ASC provided the necessary simulation codes to support test readiness as part of NNSA's national priorities.

In FY06, ASC delivered the capability to perform nuclear performance simulations and engineering simulations related to the W76/W80 LEPs to assess performance over relevant operational ranges, with assessments of uncertainty levels for selected sets of simulations. The deliverables of this milestone were demonstrated through two-dimensional (2D) and 3D physics and engineering simulations. The engineering simulations analyzed system behavior in abnormal thermal environments and mechanical response of systems to hostile blasts. Additionally, confidence measures and methods for uncertainty quantification (UQ) were developed to support weapons certification and QMU Level 1 milestones.

In FY07, ASC supported the completion of the W76-1 and W88 warhead certification, using quantified design margins and uncertainties; ASC also provided two robust 100-teraFLOPS-platform production environments by IBM and CRAY, supporting DSW and Campaign simulation requirements, respectively. One of the original ASCI program Level 1 milestones was completed when the ASC Purple system was formally declared "generally available." This was augmented by the 360-teraFLOPS ASC BlueGene/L system, which provided additional capability for science campaigns. The ASC-funded partnerships with Sandia National Laboratories (SNL)/Cray and Lawrence Livermore National Laboratory (LLNL)/IBM have transformed the supercomputer industry. By mid-2007, there were at least 34 "Blue Gene Solution" systems on the Top 500 list and 38 Cray sales based on the SNL Red Storm architecture.

In FY08, ASC delivered the codes for experiment and diagnostic design to support the CD-4 approval on the National Ignition Facility (NIF). An advanced architecture platform capable of sustaining a 1-petaFLOPS benchmark, named Roadrunner, was sited at Los Alamos National Laboratory (LANL). SNL and LANL established the collaborative Alliance for Computing at Extreme Scale (ACES) for the purpose of providing a user facility for production capability computing to the Complex. Plans were made for the Cielo capability computing platform, the first platform to be hosted through ACES, to be procured and sited at LANL.

In FY09, ASC released improved codes to support stockpile stewardship and other nuclear security missions, including secure transportation, NWC infrastructure, and nuclear forensics—specifically, a suite of physics-based models and high-fidelity databases were developed and implemented to support National Technical Nuclear Forensics activities.

In FY10, ASC will continue to deliver science-based simulation tools to support annual assessments and the next generation of LEPs. ASC will also provide tools for both experiment and diagnostic design to support the indirect-drive ignition experiments on the NIF and for improved confidence and response time for questions of vital importance to achieving predictive simulation capability. In addition, ASC will continue to provide national leadership in HPC and deploy capability and capacity platforms in support of Defense Programs campaigns.

By FY11 and beyond, ASC will focus on strengthening the science-basis and driving down uncertainties for weapons simulations to a degree that NNSA can ultimately, and credibly, claim predictive capability; instituting a robust, formalized peer review system; increasing the number of production computing cycles to support increased use of simulation in stockpile activities and reliance on UQ in weapons decisions; and pursuing exascale computing to meet time-urgent, future capability needs as documented in the *ASC Roadmap* and the *Predictive Capability Framework* (PCF).

III. Accomplishments for FY09–FY10

ASC accomplishments from Quarter 4, fiscal year 2009, through quarter 3, fiscal year 2010, are reflected below for the Computational Systems and Software Environment (CSSE) and Facility Operations and User Support (FOUS) sub-programs.

ASC headquarters (HQ) is pleased to highlight the outstanding achievements of the Defense Programs laboratories.

Computational Systems and Software Environment

LLNL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

LANL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

SNL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

Tri-Lab Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

Facility Operations and User Support

LLNL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

LANL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

SNL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

Academic Alliances

University of Chicago Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

University of Illinois at Urbana-Champaign Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

University of Utah Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

California Institute of Technology (Caltech) Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

Purdue University Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

Stanford University Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

University of Michigan Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

University of Texas, at Austin, Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

IV. Product Descriptions by the National Work Breakdown Structure

WBS 1.5.4: Computational Systems and Software Environment

The mission of this national sub-program is to build integrated, balanced, and scalable computational capabilities to meet the predictive simulation requirements of NNSA. It strives to provide users of ASC computing resources a stable and seamless computing environment for all ASC-deployed platforms, which include capability, capacity, and advanced systems. Along with these powerful systems that ASC will maintain and continue to field, the supporting software infrastructure that CSSE is responsible for deploying on these platforms includes many critical components, from system software and tools, to I/O, storage and networking, to post-processing visualization and data analysis tools, and to a CCE. Achieving this deployment objective requires sustained investment in applied R&D activities to create technologies that address ASC's unique mission-driven need for scalability, parallelism, performance, and reliability.

WBS 1.5.4.1: Capability Systems

This level 4 product provides capability production platforms and integrated planning for the overall system architecture commensurate with projected user workloads. The scope of this product includes strategic planning, research, development, procurement, hardware maintenance, testing, integration and deployment, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include strategic planning, performance modeling, benchmarking, and procurement and integration coordination. This product also provides market research for future systems.

Capability Systems Deliverables for FY11

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.2: Capacity Systems

This level 4 product provides capacity production platforms commensurate with projected user workloads. The scope of this product includes planning, research, development, procurement, hardware maintenance, testing, integration and deployment, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include the procurement and installation of capacity platforms.

Capacity Systems Deliverables for FY11

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.3: Advanced Systems

This level 4 product provides advanced architectures in response to programmatic, computing needs. The scope of this product includes strategic planning, research, development, procurement, testing, integration and deployment, as well as industrial and academic collaborations. Projects and technologies include strategic planning, performance modeling, benchmarking, and procurement and integration coordination. This product also provides market research, and the investigation of advanced architectural concepts and hardware (including node interconnects and machine area networks) via prototype development, deployment and test bed activities. Also included in this product are cost-effective computers designed to achieve extreme speeds in addressing specific, stockpile-relevant issues through development of enhanced performance codes especially suited to run on the systems.

Advanced Systems Deliverables for FY11

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.4: System Software and Tools

This level 4 product provides the system software infrastructure, including the supporting operating system environments and the integrated tools to enable the development, optimization and efficient execution of application codes. The scope of this product includes planning, research, development, integration and initial deployment, continuing product support, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include system-level software addressing optimal delivery of system resources to end-users, such as schedulers, custom device drivers, resource allocation, optimized kernels, system management tools, compilers, debuggers, performance tuning tools, run-time libraries, math libraries, component frameworks, other emerging programming paradigms of importance to scientific code development and application performance analysis.

System Software and Tools Deliverables for FY11

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.5: Input/Output, Storage Systems, and Networking

This level 4 product provides I/O (data transfer) storage infrastructure in balance with all platforms and consistent with integrated system architecture plans. The procurement of all supporting subsystems, and data transfer, storage systems and infrastructures occurs through this product. The scope of this product includes planning, research, development, procurement, hardware maintenance, integration and deployment, continuing product support, and quality and reliability activities, as well as industrial

and academic collaborations. Projects and technologies include high-performance parallel file systems, hierarchical storage management systems, storage-area-networks, network-attached storage (NAS), and HPSS or future hierarchical storage management system disks, tape, robotics, servers, and media. This product also includes relevant prototype deployment and test bed activities. Projects and technologies in the advanced networking and interconnect areas shall include networking and interconnect architectures, emerging networking hardware technologies and communication protocols, network performance / security monitoring / analysis tools, and high performance encryption and security technologies.

Input/Output, Storage Systems, and Networking Deliverables for FY11

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.6: Post-Processing Environments

This level 4 product provides integrated post-processing environments to support end-user visualization, data analysis, and data management. The scope of this product includes planning, research, development, integration and deployment, continuing customer / product support, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include tools for metadata and scientific data management, and general-purpose and application-specific visualization, analysis, and comparison. Research includes innovative data access methods and visualization of massive, complex data—the use of open-source foundations will continue to be an important strategy for development of shareable advanced techniques. The product must develop solutions to address interactivity, scaling and tri-lab access for petascale platforms, and data analysis techniques needed to support effective V&V and comparative analysis. Solutions for emerging platform architectures may in turn require customization and / or re-architecting of software to leverage hardware features. A continuing emphasis will be placed on tools for improving end-user productivity. The product also provides and supports infrastructure including office and collaborative space visualization displays, mechanisms for image data delivery, and graphics rendering hardware.

Post-Processing Environments Deliverables for FY11

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.7: Common Computing Environment

The goal of the CCE product is to enable such an environment across the tri-labs that will initially be deployed on the TLCC systems. The scope of this product includes funded R&D projects to address gap areas identified by the tri-lab technical working groups.

The CCE working groups and projects focus on a common software stack to include, but not be limited to, operating system software; application development tools; resource management; HPC monitoring and metrics; and common tri-lab environment issues of configuration management, licenses, WAN access, and multi-realm security, to name a few.

Common Computing Environment Deliverables for FY11

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5: Facility Operations and User Support

This sub-program provides both necessary physical facility and operational support for reliable production computing and storage environments as well as a suite of user services for effective use of ASC tri-lab computing resources. The scope of the facility operations includes planning, integration and deployment, continuing product support, software license and maintenance fees, procurement of operational equipment and media, quality and reliability activities, and collaborations. FOUS also covers physical space, power and other utility infrastructure, and LAN/WAN networking for local and remote access, as well as requisite system administration, cyber-security, and operations services for ongoing support and addressing system problems. Industrial and academic collaborations are an important part of this sub-program.

WBS 1.5.5.1: Facilities, Operations, and Communications (Retired)

This level 4 product was retired at the end of FY10 and replaced with two new products, which began in FY11:

- 1.5.5.4: System and Environment Administration and Operations
- 1.5.5.5: Facilities, Network, and Power

WBS 1.5.5.2: User Support Services

This level 4 product provides users with a suite of services enabling effective use of ASC tri-lab computing resources. The scope of this product includes planning, development, integration and deployment, continuing product support, and quality and reliability activities collaborations. Projects and technologies include computer center hotline and help-desk services, account management, Web-based system documentation, system status information tools, user training, trouble-ticketing systems, and application analyst support.

User Support Services Deliverables for FY11:

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5.3: Collaborations

This level 4 product provides collaboration with external agencies on specific HPC projects. The scope of this product includes planning, development, integration and deployment, continuing product support, and quality and reliability activities collaborations. This product also includes any programmatic support across the entire ASC program and studies, either by internal or external groups that enable the program to improve its planning and execution of its mission.

Collaborations Deliverables for FY11

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5.4: System and Environment Administration and Operations

This level 4 product provides necessary operational support for reliable production computing and storage environments. The following activities are included: system administration and operations, software and hardware maintenance, licenses and contracts, computing environment security and infrastructure, requirements planning, initial deployment, production computing services, and tri-lab system integration, and support.

System and Environment Administration and Operations Deliverables for FY11:

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5.5: Facilities, Network, and Power

This level 4 product provides necessary physical facility and other utility infrastructure. The following activities are included: facilities infrastructure, classified and unclassified facility networks, wide-area classified networks, ongoing network operations, infrastructure integration, and power.

Facilities, Network, and Power Deliverables for FY11:

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

V. ASC Level 1 and 2 Milestones

Table V-1. Quick Look: *Proposed* Level 1 Milestone Dependencies

Milestone ID	Milestone Title	Level	FY	Completion Date	Site(s)	Participating Program Offices
3	Baseline demonstration of UQ aggregation methodology for full-system weapon performance prediction	1	FY12	Q4	HQ, LLNL, LANL, SNL	NA 121.2 Science Campaigns ASC Campaign DSW
4	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of the initial conditions for primary boost.	1	FY12	Q4	HQ, LLNL, LANL	NA 121.2 Science Campaigns ASC Campaign
5	Assessment of weapon surety status	1	FY13	TBD	HQ, SNL	NA 121.2
6	Demonstrate predictive capability for weapon system response to short-pulsed neutrons in hostile radiation environment.	1	FY13	TBD	HQ SNL	NA 121.2
7	Full-system safety assessment	1	FY14	TBD	HQ, SNL	NA 121.2

Table V-2. Quick Look: Level 2 Milestone Dependencies for FY11⁵

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)
TBD	Improve physics and geometric fidelity simulation capability in nuclear performance code system	2	FY11	Mar-2011	IC	LLNL
TBD	Demonstrate progress on delivering AGEX simulation capabilities	2	FY11	Jun-2011	IC	LLNL
TBD	Validate thermo-mechanical coupling	2	FY11	Sep-2011	IC	LLNL
TBD	High-pressure multiscale strength model	2	FY11	Sep-2011	PEM	LLNL
TBD	Multiphase plutonium equation of state variations	2	FY11	Sep-2011	PEM	LLNL
TBD	First principles equation of state of high-explosives binders	2	FY11	Jun-2011	PEM	LLNL
TBD	Nuclear data uncertainty quantification	2	FY11	Sep-2011	PEM	LLNL
TBD	Numerical convergence study of selected burn calculations	2	FY11	Mar-2011	V&V	LLNL
TBD	PMP event expanded to over 50 events	2	FY11	Mar-2011	V&V	LLNL
TBD	UQ study of SCAMP survey events	2	FY11	Sep-2011	V&V	LLNL
TBD	Scalable applications preparation and outreach for Sequoia	2	FY11	Jun-2011	CSSE	LLNL
TBD	Deploy high-performance storage system quota system	2	FY11	Dec-2010	CSSE	LLNL
TBD	Early users on LLNL TLCC2	2	FY11	Sep-2011	FOUS	LLNL
TBD	Sequoia facilities integration	2	FY11	Sep-2011	FOUS	LLNL
TBD	Demonstrate and enhance Eulerian applications code physics and infrastructure in support of DSW, NTNF, HED, and the National Code Strategy	2	FY11	Mar-2011	IC	LANL
TBD	Develop a Lagrange application design capability to support DSW and the National Code Strategy	2	FY11	Jun-2011	IC	LANL
TBD	Production release of a neutron transport library (Monte Carlo Applications ToolKit) to support the National Code Strategy	2	FY11	Jun 2011	IC	LANL
TBD	Enhance the Eulerian applications algorithms and performance in support of the National Code Strategy	2	FY11	Sep-2011	IC	LANL

⁵ Factors such as FY11 Congressional Appropriations, NNSA/DP directives, and National Security considerations may necessitate a change in the current milestone set.

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)
TBD	Improve Lagrange application production burn capabilities to support DSW, NTNF, TR and the National Code Strategy	2	FY11	Sep-2011	IC	LANL
TBD	Next generation of charged-particle data capabilities	2	FY11	Jun-2011	PEM	LANL
TBD	Initial implementation of in-line non-local thermodynamic equilibrium capability	2	FY11	Jun-2011	PEM	LANL
TBD	Subgrid damage model for fragmentation problems	2	FY11	Sep-2011	PEM	LANL
TBD	Engineering V&V assessment high explosive model validation	2	FY11	Sep-2011	V&V	LANL
TBD	Verification testing suites	2	FY11	Sep-2011	V&V	LANL
TBD	Thermonuclear applications V&V assessment of physics modeling capabilities in an ASC code near thresholds	2	FY11	Sep-2011	V&V	LANL
TBD	Visualization cluster upgrade project	2	FY11	Sep-2011	CSSE	LANL
TBD	Improvements in data structures and communications in refactored applications	2	FY11	Sep-2011	CSSE	LANL
TBD	Time-dependent NWM21 radiation environment	2	FY11	Dec-2010	IC	SNL
TBD	B61 mechanical safety and security	2	FY11	Sep-2011	IC	SNL
TBD	III-V semiconductor models	2	FY11	Sep-2011	IC	SNL
TBD	Dynamically integrated design analysis environment	2	FY11	Sep-2011	IC	SNL
TBD	Validated material failure model in Sierra for B61 abnormal mechanical environments	2	FY11	Sep-2011	PEM	SNL
TBD	Next generation NT simulation arc physics models for source plasma creation	2	FY11	Sep-2011	PEM	SNL
TBD	Predict the aerodynamic performance of a stockpile gravity bomb with SIERRA	2	FY11	Sep-2011	V&V	SNL
TBD	QMU study for abnormal mechanical environments	2	FY11	Sep-2011	V&V	SNL
TBD	Cavity SGEMP V&V	2	FY11	Dec-2010	V&V	SNL
TBD	Deploy TLCC11 clusters	2	FY11	Sep-2011	FOUS	SNL
TBD	Cielo capability computing platform integration readiness	2	FY11	Dec-2010	CSSE	LANL, SNL
TBD	TLCC2 contract awarded	2	FY11	Mar-2011	CSSE	LLNL, LANL, SNL
TBD	Common computing environment FY11	2	FY11	Sep-2011	CSSE	LLNL, LANL, SNL
TBD	Develop TOSS 2.0	2	FY11	Sep-2011	CSSE	LLNL, LANL, SNL

Table V-3. Quick Look: *Preliminary* Level 2 Milestone Dependencies for FY12

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)
TBD	Implement improved algorithms for loading on structures	2	FY12	Mar-2012	IC	LLNL
TBD	Extend ALE AMR capabilities to additional physics packages	2	FY12	Sep-2012	IC	LLNL
TBD	Low-pressure multiscale strength model	2	FY12	Sep-2012	PEM	LLNL
TBD	Equation of state variations of additional materials	2	FY12	Sep-2012	PEM	LLNL
TBD	Boost validation suite for high explosives	2	FY12	Sep-2012	PEM	LLNL
TBD	Develop multi-ion center plasma equation of state code	2	FY12	Mar-2012	PEM	LLNL
TBD	Nuclear data uncertainty Quantification	2	FY12	Sep-2012	PEM	LLNL
TBD	Continued UQ study of SCAMP survey events	2	FY12	Sep-2012	V&V	LLNL
TBD	Scalable applications preparations and outreach for Sequoia	2	FY12	Jun-2012	CSSE	LLNL
TBD	Deploy SLURM on Sequoia	2	FY12	Sep-2012	CSSE	LLNL
TBD	Improve the Eulerian applications codes through additional physics and algorithms to allow validation via high energy density experiments	2	FY12	Mar-2012	IC	LANL
TBD	Expand Lagrange application 3D hydro capabilities in support of DSW	2	FY12	Jun-2012	IC	LANL
TBD	Enhance Eulerian applications physics and infrastructure to support multiple mission areas	2	FY12	Sep-2012	IC	LANL
TBD	Conduct a Lagrange application physics modeling strategy assessment in support of DSW	2	FY12	Sep-2012	IC	LANL
TBD	New constitutive thermo-mechanical model for high explosives	2	FY12	Dec-2011	PEM	LANL
TBD	Baseline an ASC code for an emergency response application and develop plan to meet future requirements	2	FY12	Mar-2012	PEM	LANL
TBD	SESAME uranium update	2	FY12	Mar-2012	PEM	LANL
TBD	Common mix modeling	2	FY12	Sep-2012	PEM	LANL
TBD	Engineering V&V assessment of a weapon subassembly in an ACRF experiment	2	FY12	Sep-2012	V&V	LANL
TBD	Assessment of predictive capability for primary performance using LANL primary validation suite	2	FY12	Mar-2012	V&V	LANL

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)
TBD	Benchmark evaluation of predictive capability for boost using LANL boost validation suite	2	FY12	Jun-2012	V&V	LANL
TBD	Programming models and data analysis environments for extreme-scale computing	2	FY12	Sep-2012	CSSE	LANL
	Application deployment of a quick parallel log-structured file system capability	2	FY12	Sep-2012	CSSE	LANL
TBD	High-performance storage system 8.1 deployment	2	FY12	Sep-2012	CSSE	LANL
TBD	Cavity SGEMP predictive capability for realistic RB geometry	2	FY12	Mar-2012	IC	SNL
TBD	One-way coupling of re-entry aerodynamics with ablation to structural analysis simulations	2	FY12	Sep-2012	IC	SNL
TBD	Sierra Toolkit conversion, Phase 2	2	FY12	Sep-2012	IC	SNL
TBD	Gas transfer system performance models for hydrogen embrittlement	2	FY12	Sep-2012	PEM	SNL
TBD	B61 normal environment tape joint performance	2	FY12	Sep-2012	PEM	SNL
TBD	Computational uncertainty quantification for the QASPR Project	2	FY12	Sep-2012	V&V	SNL
TBD	Enhanced solution verification capability in Encore, applied to abnormal thermal QMU	2	FY12	Sep-2012	V&V	SNL
TBD	Verification and validation of normal mechanical environments for B61 System	2	FY12	Sep-2012	V&V	SNL
TBD	Demonstration of a legacy application's path to exascale	2	FY12	Mar-2012	CSSE	SNL
TBD	Cielo capability computing platform production readiness	2	FY12	Dec-2011	CSSE	LLNL, LANL, SNL

Detailed Milestone Descriptions for FY11

Milestone (ID#): Scalable applications preparation and outreach for Sequoia		
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC
Completion Date: June 30, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
<p>Description: Building on the FY10 SAP milestone, the SAP effort will extend the knowledge base, documentation, and training to enable ASC code teams to utilize Sequoia. SAP will actively engage tri-lab code teams to address their needs in porting codes to the Sequoia IF (Dawn) and in preparing for the arrival of Sequoia in FY12. For FY11, several multi-physics codes will be engaged to characterize the Sequoia ID (Dawn) performance, analyze bottlenecks and load balance issues, and to develop strategies for improving performance targeting the Sequoia system. Additional refinements to understanding and performance enhancements will be achieved for codes targeted in the initial SAP effort. A deployment plan for development environments tools will be developed including initial testing and validation of the tool suite.</p>		

Milestone (ID #): Deploy high-performance storage system quota system				
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC		
Completion Date: December 30, 2010				
ASC nWBS Subprogram: CSSE				
Participating Sites: LLNL				
Participating Programs/Campaigns: ASC				
Description: The LC’s HPSS archive annual growth will soon exceed projected supporting budgets. The Annual Archive Allowance System (AAAS) will allow LC management and administrators to establish annual storage growth allowances (quotas) in partnership with users, programs and projects. Users, managers, and administrators will have role-based means with which to monitor and manage archival storage growth both on a per-user and project basis. When allowances are exceeded, notifications will be made to users and warnings will be posted in management-viewable reports.				
Completion Criteria: This project is complete when the AAAS monitoring and administration tool is deployed to LC users in OCF and SCF environments.				
Customer: LC				
Milestone Certification Method: A report will be written that documents deployment of the AAAS system and infrastructure in the LC A memo will be written that documents the handoff of the developed and deployed capability to Michel McCoy, ASC Program Leader at LLNL.				
Supporting Resources: LC High Performance Systems Division, CSSE personnel				
Supporting Milestones:				
Program		Title		Due Date
N/A		N/A		N/A
Codes/Simulation Tools Employed: None				
Contribution to the ASC Program: Required for successful management of ASC archival storage system resources in order to allow simulation results to continue being cost-effectively retained within LC archives.				
Contribution to Stockpile Stewardship:				
No.	Risk Description	Risk Assessment (low, medium, high)		
		Consequence	Likelihood	Exposure
1	AAAS is not integrated in a timely fashion, users exceed budgeted archival storage space resulting in the inability to store subsequent simulation results in the archive	High	Low	Low

Milestone (ID#): Early users on LLNL TLCC2				
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC		
Completion Date: September 30, 2011				
ASC nWBS Subprogram: FOUS				
Participating Sites: LLNL				
Participating Programs/Campaigns: ASC				
Description: This milestone encompasses all the work past TLCC2 contract award associated with TLCC2 system integration including hardware and software troubleshooting, required electrical and mechanical facilities integration necessary for system deployment, acceptance testing of hardware, and deployment and integration of at least one scalable unit on the unclassified network. The end product of this milestone will be one or more Limited Availability TLCC2 scalable units functioning properly on the unclassified network with at least one early user running science codes.				
Completion Criteria: This project is complete when a user is running science codes on one or more TLCC2 scalable units in the LC's OCF environment.				
Customer: ASC				
Milestone Certification Method: A report will be written that documents the completion of the synthetic workload testing, acceptance and deployment of a TLCC2 scalable unit to the unclassified network in the LC. A memo will be written that documents the handoff of the developed and deployed system to Michel McCoy, ASC Program Leader at LLNL.				
Supporting Resources: LC High Performance Systems Division, CSSE personnel				
Supporting Milestones:				
Program	Title	Due Date		
N/A	N/A	N/A		
Codes/Simulation Tools Employed: N/A				
Contribution to the ASC Program: Required to provide capacity computing cycles necessary for simulation in support of stockpile stewardship.				
Contribution to Stockpile Stewardship: Provides capacity computing cycles necessary for stockpile stewardship.				
No.	Risk Description	Risk Assessment (low, medium, high)		
		Consequence	Likelihood	Exposure
1	Hardware issues in TLCC2 delay ability to deploy.	High	Medium	Medium
2	Technology production issues from vendors delays ability to deploy TLCC2.	High	Medium	Medium
3	Delays in the TLCC2 contract award impacts ability to deploy.	High	Low	Medium

Milestone (ID#): Sequoia facilities integration				
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC		
Completion Date: September 30, 2011				
ASC nWBS Subprogram: FOUS				
Participating Sites: LLNL				
Participating Programs/Campaigns: ASC				
Description: This milestone encompasses the work required to site the Sequoia system. This includes the liquid cooling infrastructure, electrical distribution from bottom floor to the computer room, the electrical wiring and installation in the room itself and mechanical and electrical infrastructure required to site Sequoia. The end product of this milestone is electrical and mechanical capabilities available for successful siting of the initial delivery of Sequoia.				
Completion Criteria: This project is complete when a memo certifying Sequoia facility readiness is delivered to Michel McCoy, ASC Program Leader.				
Customer: ASC				
Milestone Certification Method: A report will be written that documents the completion of the mechanical and electrical facilities necessary to site Sequoia. A memo will be written that documents the readiness of the facility for Sequoia siting to Michel McCoy, ASC Program Leader at LLNL.				
Supporting Resources: LC High Performance Systems Division, CSSE personnel				
Supporting Milestones:				
Program	Title		Due Date	
N/A	N/A		N/A	
Codes/Simulation Tools Employed: N/A				
Contribution to the ASC Program: Required to enable deployment of Sequoia computing cycles necessary for simulation (UQ and Boost) in support of stockpile stewardship.				
Contribution to Stockpile Stewardship: Provides computing cycles necessary for stockpile stewardship.				
No.	Risk Description	Risk Assessment (low, medium, high)		
		Consequence	Likelihood	Exposure
1	Modifications in vendor scope for the solution.	High	Medium	High
2	Delay in design/build construction completion of highly complex systems.	High	Medium	High

3	Commissioning first machine level liquid cooling system from vendor.	Medium	Medium	High
4	Uncertainty in projected electrical consumption for the full computer.	High	High	Medium

Milestone (ID#): Visualization cluster upgrade project		
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC
Completion Date: September 30, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC/CSSE		
Description: The focus of this milestone will be to provide the necessary resources to visualize output generated on petascale clusters. Requirements will be developed, equipment will be purchased, and the cluster will be integrated into the LANL computer center. The milestone will be complete when the cluster is ready for production work.		

Milestone (ID#): Improvements in data structures and communications in refactored applications		
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC
Completion Date: September 30, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC/CSSE, ASC/IC		
Description: This milestone implements new data structures, communications, and parallel I/O in ASC codes through Crestone refactoring project, and it demonstrates the efficiency and improvement of the new implementations through real problems.		

Milestone (ID#): Deploy TLCC11 clusters		
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC
Completion Date: September 30, 2011		
ASC nWBS Subprogram: FOUS		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Deploy next generation ASC TLCC systems into production computing environments.		

Milestone (ID #): Cielo capability computing platform integration readiness										
Level: 2		Fiscal Year: FY11		DOE Area/Campaign: ASC						
Completion Date: December 31, 2010										
ASC nWBS Subprogram: CSSE										
Participating Sites: LANL, SNL										
Participating Programs/Campaigns: ASC										
Description: The New Mexico Alliance for Computing at Extreme Scale (ACES) partnership between LANL and SNL is responsible for the deployment and integration of the Cielo platform that will be sited at LANL. Cielo is ready for integration into the LANL computing center. Cielo is ready for on-site integration into the local and remote computing infrastructure, including the user software environment.										
Completion Criteria: Follows the ASC Level 2 Milestone criteria for capability platforms: system hardware deliveries from vendor to site are complete, including the basic hardware to integrate “the system” as contractually defined; installation of the system by the contractor on-site to the extent that is contractually required is substantially complete; in general, contractual requirements for formal hardware acceptance have been substantially completed; system software needed for basic operation of the system is delivered, tested, and demonstrated to be operational; vendor has completed on-site capability scaling testing and demonstration; and system is ready to begin on-site integration into local computing environment.										
Customer: NNSA / ASC HQ, tri-lab ASC program managers responsible for CCCs, SSP, tri-lab weapons applications community.										
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.										
Supporting Resources: CSSE, FOUS, platform funding, ACES program managers, LANL facilities.										
Supporting Milestones: <table><tr><td>Program</td><td>Title</td><td>Due Date</td></tr><tr><td>N/A</td><td>N/A</td><td>N/A</td></tr></table>					Program	Title	Due Date	N/A	N/A	N/A
Program	Title	Due Date								
N/A	N/A	N/A								
Codes/Simulation Tools Employed: N/A										
Contribution to the ASC Program: Provides production capability compute cycles to ASC Program including scalable performance.										
Contribution to Stockpile Stewardship: Primary production capability platform for the ASC Program.										
No.	Risk Description	Risk Assessment (low, medium, high)								
		Consequence	Likelihood	Exposure						
1.	System is not delivered on schedule.	High	Low	Medium						

Milestone (ID#): TLCC2 contract awarded		
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC
Completion Date: March 31, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: Develop, issue, and evaluate the RFP for the TLCC2 platform and award a contract.		

Milestone (ID#): Common Computing Environment FY11		
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC
Completion Date: September 30, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC/CSSE		
Description: TBD		

Milestone (ID#): Develop TOSS 2.0		
Level: 2	Fiscal Year: FY11	DOE Area/Campaign: ASC
Completion Date: September 30, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC/CSSE		
Description: Deploy CCE capabilities developed during FY10 and FY11, including the next major release of common operating system (TOSS 2.0) and software stack. Prepare for deployment of the next generation of the AC TLCC systems, which may include hardware and software integration and testing for the tri-lab environment.		

Milestone Descriptions for Preliminary FY12

Milestone (ID#): Scalable applications preparations and outreach for Sequoia		
Level: 2	Fiscal Year: FY12	DOE Area/Campaign: ASC
Completion Date: June 30, 2012		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: With the delivery of the Sequoia system in 1QFY12, the Scalable Applications Preparation (SAP) effort will fully deploy the applications development environment for the new system. SAP will evaluate the utility of the environment, address deficiencies that may be identified, and assist initial applications code teams with issues encountered. Preliminary performance of applications and benchmarks on the Sequoia hardware will be evaluated.		

Milestone (ID#): Deploy SLURM on Sequoia		
Level: 2	Fiscal Year: FY12	DOE Area/Campaign: ASC
Completion Date: September 30, 2012		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: The SLURM resource manager will be ported to Sequoia.		

Milestone (ID#): Programming models and data analysis environments for extreme-scale computing		
Level: 2	Fiscal Year: FY12	DOE Area/Campaign: ASC
Completion Date: September 30, 2012		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC/CSSE		
Description: Explore, quantitatively investigate, and report on the technological choices for programming models and data analysis environments on petascale, potentially hybrid, multi-core computing systems. Establish plans and goals for FY13 and FY14 for enabling application development for extreme-scale computer systems.		

Milestone (ID#): Application deployment of a quick parallel log-structured file system capability		
Level: 2	Fiscal Year: FY12	DOE Area/Campaign: ASC
Completion Date: September 30, 2012		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC / CSSE		
Description: Deployment and assessment of PLFS with HASH in multiple production ASC applications on a production machine.		

Milestone (ID#): High-performance storage system 8.1 deployment		
Level: 2	Fiscal Year: FY12	DOE Area/Campaign: ASC
Completion Date: September 30, 2012		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC / CSSE		
Description: Includes 8.1 placed in General Availability in 2nd quarter of FY12. Installed in LANL open environment in 3rd quarter FY12. Installed in LANL secure environment 4th quarter FY12.		

Milestone (ID#): Demonstration of a legacy application's path to exascale		
Level: 2	Fiscal Year: FY12	DOE Area/Campaign: ASC
Completion Date: March 31, 2012		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC, DOE Office of Science INCITE Program		
Description: Cielo is expected to be the last capability system on which existing ASC codes can run without significant modifications. This assertion will be tested to determine where the breaking point is for an existing highly scalable application. The goal is to stretch the performance boundaries of the application by applying recent CSSE R&D in areas such as resilience, power, I/O and VIZ services, SMARTMAP, lightweight kernels, virtualization, simulation, and feedback loops. An existing INCITE award on Jaguarpf and/or CCC allocations will be used to quantify the impact of system-level changes to extend the life and performance of the ASC code base. Simulation will be		

used to supplement the INCITE/CCC calculations at higher scales than are currently available.

Milestone (ID#): Cielo capability computing platform production readiness		
Level: 2	Fiscal Year: FY12	DOE Area/Campaign: ASC
Completion Date: December 31, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: The New Mexico Alliance for Computing at Extreme Scale (ACES) partnership between LANL and SNL is responsible for the deployment and integration of the Cielo Platform that will be sited at LANL. Cielo shall achieve Production Capability Readiness as defined by the Capability Platform Level 2 Milestones Working Group. In summary, this includes the platform is made available for Capability Computing Campaign (CCC) capability work; all system software, tools, utilities and user support processes are available and fully functional; ASC applications targeted for the platform are ported and made available to designers, analysts, and engineers; the platform has demonstrated acceptable reliability performance targets.		

VI. ASC Roadmap Drivers for FY11–FY12

Table VI-1. ASC Roadmap Drivers for FY11-12⁶

The table will be added in Rev. 0.1 of this document.

⁶ The ASC Top Ten Risks table was originally published in the *ASC Program Plan FY05*.

VII. ASC Risk Management

Risk management is a process for identifying and analyzing risks, executing mitigation and contingency planning to minimize potential consequences of identified risks, and monitoring and communicating up-to-date information about risk issues. Risk management is about identifying opportunities and avoiding losses. A “risk” is defined as (1) a future event, action, or condition that might prevent the successful execution of strategies or achievement of technical or business objectives, and (2) the risk exposure level, defined by the likelihood or probability that an event, action, or condition will occur, and the consequences, if that event, action, or condition does occur. Table VII-1 summarizes ASC’s top ten risks, which are managed and tracked.

Table VII-1. ASC’s Top Ten Risks⁷

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
1	Compute resources are insufficient to meet capacity and capability needs of designers, analysts, DSW, or other Campaigns.	High	High	HIGH	Integrate program planning with DSW and other Campaigns, to ensure requirements for computing are understood and appropriately set; maintain emphasis on platform strategy as a central element of the program; pursue plans for additional and cost-effective capacity platforms.
2	Designers, analysts, DSW, or other Campaign programs lack confidence in ASC codes or models for application to certification / qualification.	Very High	Low	MEDIUM	Maintain program emphasis on V&V; Integrate program planning with DSW and other Campaign programs to assure requirements needed for certification / qualification are properly set and met.

⁷ The ASC Top Ten Risks table was originally published in the *ASC Program Plan FY05*.

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
3	Inability to respond effectively with Modeling & Simulation (M&S) capability and expertise in support of stockpile requirements – near or long term, planned or unplanned (LEP, SFIs, etc.).	Very High	Low	MEDIUM	Integrate program planning, particularly technical investment priority, with DSW and other Campaign programs to ensure capability and expertise is developed in most appropriate areas; retain ability to apply legacy tools, codes, models.
4	Base of personnel with requisite skills, knowledge, and abilities erodes.	High	Low	MEDIUM	Maintain emphasis on “best and brightest” personnel base, with Institutes, Research Foundations, and University programs, as central feeder elements of the program.
5	Advanced material model development more difficult, takes longer than expected.	Moderate	High	MEDIUM	Increase support to physics research; pursue plans for additional computing capability for physics and engineering model development
6	Data not available for input to new physics models or for model validation.	High	Moderate	MEDIUM	Work with Science and Engineering Campaigns to obtain needed data; propose relevant experiments.
7	Infrastructure resources are insufficient to meet designer, analyst, DSW, or other Campaign program needs.	High	Low	MEDIUM	Integrate program planning with DSW and other Campaigns, to ensure requirements for computing are understood and appropriately set; maintain emphasis on system view of infrastructure and PSE strategy, as central elements of the program.
8	External regulatory requirements delay program deliverables by diverting resources to extensive compliance-related activities	Moderate	Low	MEDIUM	Work with external regulatory bodies to assure that they understand NNSA’s mission, ASC’s mission, and the processes to set and align requirements and deliverables, consistent with applicable regulations.

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
9	Inadequate computational environment impedes development and use of advanced applications on ASC platforms.	Moderate	Very Low	LOW	Integrated planning between program elements to anticipate application requirements and prioritize software tools development and implementation.
10	Fundamental flaws discovered in numerical algorithms used in advanced applications require major changes to application development.	Moderate	Very Low	LOW	Anticipate or resolve algorithm issues through technical interactions on algorithm research through the Institutes, ASC Centers, and academia, and focus on test problem comparisons as part of software development process.

VIII. Performance Measures

Table VIII-1. ASC Campaign Annual Performance Results (R) and Targets (T)

The table will be added in Rev. 0.1 of this document.

IX. Budget

Budget information will be added in Rev. 0.1 of this document.

Appendix A. Glossary

The glossary will be added in Rev. 0.1 of this document.

Appendix C. Points of Contact

The points of contact will be added in Rev. 0.1 of this document.

Appendix D.

WBS 1.5.1.4-TRI-001 Academic Alliance Centers

The Academic Alliance Centers project includes research activities at the funded academic centers. Currently, there are five universities that are part of the Predictive Science Academic Alliance Program (PSAAP) program, as listed below:

- California Institute of Technology (Caltech)
- Purdue University
- Stanford University
- University of Michigan
- University of Texas, at Austin

The Academic Strategic Alliance Program (ASAP) centers at the University of Chicago, University of Illinois at Urbana-Champaign (UIUC), and University of Utah closed out the activities funded by NNSA at end of FY10.

California Institute of Technology

The Center for the Predictive Modeling and Simulation of High-Energy Density Dynamic Response of Materials

Academic Alliance Center information will be added in Rev. 0.1 of this document.

Purdue

Center for Prediction of Reliability, Integrity, and Survivability of Microsystems

Academic Alliance Center information will be added in Rev. 0.1 of this document.

Stanford University

The Center for Predictive Simulations of Multi-Physics Flow Phenomena with Application to Integrated Hypersonic Systems

Academic Alliance Center information will be added in Rev. 0.1 of this document.

University of Michigan

Academic Alliance Center information will be added in Rev. 0.1 of this document.

University of Texas

The Center for Predictive Engineering and Computational Sciences

Academic Alliance Center information will be added in Rev. 0.1 of this document.

Appendix E. ASC Obligation/Cost Plan

The ASC Cost Plan information will be added in Rev. 0.1 of this document.

Figure E-1. ASC obligation/cost plan for FY11.